

18-644 Fall 2013 Project Proposal: GPS Bus Tracker

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Abstract

In this paper, we will propose a novel way to track busses and accurately predict arrival times. We start by formally stating the problem and its importance. We then list the competition and their subsequent limitations. Lastly, we describe our idea and list the various benefits associated with implementing our idea.

1. The Problem

Public transportation can be an important asset to any city. If widely used, it can improve air quality, reduce traffic congestion, and more importantly provide transportation for low income families [3] and those who do not have cars. However, in Pittsburgh (and many other cities across the country) the public transportation is very unreliable. The bus system posts schedules, but can rarely stick to them. This can cause up to an hour delay between the scheduled time and the bus arrival time. For many people, this uncertainty makes the bus system practically unusable. Because of this, fewer and fewer people are using public transportation regularly. This results in the bus company earning less revenue and consequently reducing the number of bus routes. If this trend continues, bus companies will not be able to stay in business, leaving many people without any mode of transportation.

2. Importance

Making public transportation more user friendly could entice many more people to use it. This would not only increase revenues for the bus company, but would create a valuable resource for the residents of the city. More people could rely on the bus system on a regular basis and could increase the quality of living in the city in general.

3. Competition

Name	Limitation
Google Maps	Only posts scheduled times
CTA Bus Tracker	Chicago specific (not easily expandable)[1]
Tiramisu	Relies on individuals to report bus activity (crowdsourced) [2]
Maimi-Dade Bus Tracker	Miami Specific, Only tracks a single route

4. Our Idea

We wish to predict bus arrival times via GPS tracking of all buses in Pittsburgh. GPS modules placed on each bus would transmit the buses coordinates to a server application via cell networks. The server could then serve bus location data to users via the internet, who may be accessing the data through their mobile devices.

While GPS data will let users know where buses are, it may not let them know how long it will take for the bus to arrive at their stop. The user will not be able to know if the bus is stuck in traffic, or if it will arrive within a reasonable amount of time. The Pittsburgh bus schedule already shows how long it usually takes for a bus to travel between stops. In the absence of traffic, this data can be used to determine when the bus will arrive, based on its current position along the route.

In order to give users accurate results regardless of conditions, traffic patterns must be gathered in real time, or be based on a record of past traffic patterns. One approach which we are considering taking is the use of Google traffic data. By querying Google traffic data in real time along the buses route, the appropriate traffic delay can be added based on the situation. The other approach we are considering would be to accumulate a model of traffic patterns over a time period. This data, accumulated from past bus runs, would allow arrival time on a route to be predicted during a certain time of day. The actual position data and journey times of buses could be used to make the model more accurate. For the time period used for the model, longer time periods would allow more accurate predictions, but shorter time periods allow for faster adaption and deployment. We've determined that the best compromise would be week-long cycles.

The hardware module would require a GPS receiver, a processing unit, and a cellular modem. For our proof of concept, we will use an Arduino for the processing unit. For the modem component, we will use an inexpensive cell phone connected to a circuit board which can access the cellular modem via the phone serial port.

5. Benefits of Our Idea

Our idea is more effective than current methods for 3 main reasons:

- **Reliability:** Because our system uses real hardware instead of relying on crowdsourcing techniques, the quality of service does not vary by time of day or by popularity.
- **Easy Set Up:** Our system can leverage the bus route data that is currently present in Google Maps. Because of this, our system can be easily ported to different cities and different

- public transportation modes.
- **Accurate Prediction:** Our system will have the ability to accurately predict arrival times for busses by learning trends. These trends will be based upon time of day as well as other historical factors. This can create a much more intelligent prediction mechanism compared to other bus tracking services.

References

- [1] "Cta bus tracker." [Online]. Available: <http://www.ctabustracker.com/bustime/home.jsp>
- [2] "Tiramisu, the real-time bus tracker." [Online]. Available: <http://www.tiramisutransit.com/t/about>
- [3] Madelaine Criden, "Recognizing the importance of public transportation for low-income households," 2007.